AN ANALYSIS OF STUDENT GRADING AT THE NAVAL POSTGRADUATE SCHOOL

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THESIS

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by

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June 1973

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by

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
June 1973

ABSTRACT

Among the significant controls influencing the academic excellence of a university are the mechanics and philosophy of the student grading system. The Naval Postgraduate School (NPS) has used three grading systems within a recent time period. The findings of faculty and student questionnaires indicate strong support for the plus/minus grading system over the more traditional ABCDX system. The Quality Point Ratio data for the initial two quarters of implementation of the plus/minus system reflect no significant trend which can be attributed to the change in grading systems. There is strong student opinion in favor of a further change to a pass/fail grading system. Recommended is an extensive study of the operational grading system in use by the Aeronautics Department at NPS.

TABLE OF CONTENTS

LIST OF TABLES

I. INTRODUCTION

A. STATEMENT OF THE PROBLEM

According to a survey by the American Associations of College Registrars and Admissions Officers, 61% of this country's colleges and universities have incorporated non-traditional methods of student evaluation into their grading systems.[1] Traditional methods of grading have been the ranking of students along an ABCDX spectrum or on a 100 to 0 scale. The definite trend is towards the use of standards such as "pass" and "fail" or "credit" and "no-credit".

The Naval Postgraduate School used the traditional grading system of ABCDX from 1947 until quarter III of academic year 1972. Modification of that system had been under consideration since June 1970. A student and faculty referendum was conducted prior to the implementation of the grading systems presently in use. The student referendum is summarized in the interest of background information for this paper:

1,364 students (82% of the student body) responded to the two-part questionnaire. The individual was asked to choose between the ABCDX and the plus/minus grading systems. 1,011 (74%) preferred the ABCDX system. 353 (26%) preferred

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[1] Maeroff, G., "More Schools Abandoning Traditional Letter Grades," New York Times, p. 45, January 14, 1973.

the plus/minus system. In the second question the student was asked his preference of the ABCDX, plus/minus, and pass/fail grading systems. 427 (31.3%) preferred the ABCDX system. 168 (12.3%) preferred the plus/minus system and 769 (56.3%) preferred the pass/fail system.

The faculty referendum consisted of seven questions. Only the specific questions and results of background interest are presented:

1) Four versions of the Naval Postgraduate School grading system are indicated. Specify your preference.

Plan A	Plan B	Plan C	Plan D (no letter grades)
A 3.0	A 3.0	A 3.0	3.0
B 2.0	B+2.5	A-22/3	2.8
C 1.0	B 2.0	B+21/3	2.6
D 0.0	C+1.5	B 2.0	2.4
X-1.0	C 1.0	B-12/3	2.2
	D+0.5	C+11/3	2.0
	D 0.0	C 1.0	.
	X-1.0	C- 2/3	.
		D+ 1/3	.
		D 0.0	0.8
		X -1.0	-1.0

	Strongly favor	Favor	Neutral	Against	Strongly against
Plan A	13	29	42	35	23
Plan B	28	49	34	20	16
Plan C	31	32	18	38	24
Plan D	18	18	24	37	45

2) The present Naval Postgraduate School grading system (Plan A) has a Quality Point Rating scale which ranges from -1.0 to 3.0. Would you be in favor of shifting this scale so that it ranges from 0.0 to 4.0?

Strongly favor	Favor	Neutral	Against	Strongly against
46	26	50	16	7

3) Would you be in favor of pass/fail grades for a course when an Academic Department as a whole agrees that the nature of the course is such that pass/fail grades are more appropriate than letter grades?

Strongly favor	Favor	Neutral	Against	Strongly against
53	60	13	8	6

In summary, the Naval Postgraduate School faculty favored a finer division of grades relative to the ABCDX system. A change to a quality point scale of 0.0 to 4.0 was favored and restricted use of pass/fail grades was strongly favored.

At the beginning of quarter III, AY-72, a plus/minus system was introduced for the optional use by all instructors except for the Aeronautical Engineering Department. For this specific department an operational grading system, which is a modified pass/fail system, was introduced on a three year trial basis.

This paper reviews the results of the current grading systems through faculty and student surveys and through statistical analysis of appropriate data obtained from the Naval Postgraduate School Registrar. The specific hypotheses tested are the following:

Hypothesis I: The plus/minus grading system currently being used at the Naval Postgraduate School is superior to the former ABCDX grading system.

Hypothesis II: A change from the present plus/minus grading system to a pass/fail system would bring a lowering

of the School's academic standards because student motivation to study is dependent to a significant degree upon a competitive grading system.

B. ON THE NATURE OF GRADES AND THEIR SUBJECTIVE ARGUMENTS

1. Grades In General

The various proposals and arguments presented in the bibliographical sources of this paper indicate that there is a widespread and increasingly vocal dissatisfaction regarding the validity and usefulness of the current methods for evaluating student abilities and achievement. The arguments are directed mainly at the traditional grading system.

The concerns address three main areas of dissatisfaction.[2] First, the use of letter grades, with associated numerical values, presents a deceptive appearance of objectivity and precise evaluation. With the judgment reduced to a neat single letter to which a numerical value can be assigned, the apparent precision of the record in reality conceals a host of assumptions, variables, and methods by which such a record is determined. Second, it is claimed that the use of letter grades and grade point averages distorts and debases the entire learning process of the individual, of students in relation to each other, and of students in relation to their instructors. Third, letter

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[2] Benson, W. W., "Graduate Grading Systems," Proceedings Of Nineth Annual Meeting: Council Of Graduate Schools in the United States, p. 106, December 4-6, 1969.

grades and grade point averages, because of their assumed accuracy, are often put to questionable use by the university and society.

The defense of the letter grading system is in many ways a mirror image of the attacks. Much of the case for the traditional system rests on its durability and practicality. Even if errors, inconsistencies, and a false sense of accuracy are conceded, there remains the fact that the wide use of one system in which education in its entirety has had long experience has its benefits for students, faculty, administrators, and society in general. Most academicians recognize that a B grade at one university may mean something different than a B grade in another. But experience in the use of letter grades, both internally and externally, helps to guard against misuse and misinterpretation. As a common currency, grades facilitate student movement from one school to another. At a time when colleges and graduate schools have been overwhelmed with applications for admissions, the traditional grade point average is one of the most consistent indicators of student potential. Graduate deans and admissions officers ask how applications for admissions to graduate school can be processed if instead of grades and supporting recommendations, they had to interpret extensive dossiers in an attempt to discriminate among candidates.[3]

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[3] Davis, J. A., Great Aspirations, p. 226, McGraw-Hill, 1964.

As for the other areas of attack, the defenders of the traditional system can identify off-setting benefits. Grades provide a description of progress for students, protecting many from sporadic patterns of study or no study. Grades provide a student with a measure of his own comprehension of a subject and his progress in learning. A student's grade profile serves to indicate for him, and others, areas of particular interest and capability.

For the instructor, conscientious grading can serve to indicate the success and failure of his instructional methods and to indicate the kinds of approaches that might be of greatest benefit to other instructors. Furthermore, in the course of time, a large number of courses and grades tend to balance out the false assumptions and inaccuracies that individual grades may hide, and provide a shorthand communication useful to the students, the instructors, the university administrators, and to prospective employers. Finally, there is a type of personal accountability inherent in grading systems. Instructors, in general, have little or no pretense of perfection in their academic accounting systems, and students should realize that throughout their lives their actions, abilities, and achievements will constantly come under evaluation, as do the actions, abilities, and achievements of virtually every responsible member of our society.

2. Specific Problems

There are six specific technical problems relating to the assignment of grades to students.

"(1) On what should a grade be based?

(2) How should component data be weighed in arriving at a grade?

(3) In how many categories should grades be reported?

(4) What fraction of students should receive each grade?

(5) In relation to what frame of reference should marks be formulated and how can they be related to that frame?

(6) How can standards be equated from course to course and department?" [4]

Not all of these problems are relevant at the graduate school level. One significant problem is: on what a grade should be based. At the graduate level, a grade should represent a pure and accurate appraisal of student competence. Some of the factors that tend to modify this concept are:[5]

(a) The quantity of work completed in addition to, or even instead of, academic competence. When instructors allow students the option of additional work to raise or

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[4] Thorndike, R. L., Hagen, E., Measurement and Evaluation in Psychology and Education, 3rd Ed., p. 575, John Wiley & Sons, 1969.

[5] Thorndike, R. L., Hagen, E., op. cit., p. 578

solidify a grade, then the grade represents industry as well as competence.

(b) The mechanical aspects of completed work, such as neatness and grammatical usage, often modify the grade representation.

(c) Aptitude, as indicated to the instructor by which section the student is assigned, can modify the grade representation.

Student evaluations can be reported very crudely in only two categories such as pass/fail, in four or five categories such as ABCDX, or in a fifteen category system that attaches plusses and minuses to the above. Arguments concerning the values involved tend to center around de-emphasizing the competitive pressures and the presumably irrelevant goals represented by grades. It is often suggested that this can best be accomplished by a very coarse grading system which makes few discriminations. This gain is made at the expense of most of the information that the grading system might possibly supply about the individual. For instance, in a three category system it is known that the great majority of students were judged to be neither outstanding nor inadequate. Grades recede into the background except for those that fail and excel. As the number of discriminations increases beyond the three category system, distinctions begin to be of importance to all students. If the number of categories is small, there are relatively few students who fall close to dividing lines

between categories, and for these a very major gain or loss occurs depending on which way the decision goes. As the number of categories increases, the number of borderline decisions increases correspondingly, but each decision becomes less crucial in the total academic record of the student. There is a trade-off of increased frequency of potential error, or unfairness, in grading, for decreased size of error.

Much has been written about the appropriate frequency distribution of grades. The first significant principle is that grades are basically ordinal and not a cardinal system.[6] It is generally accepted that in the traditional ABCDX system that the steps from one letter grade to another are not equal steps of quality. For example, it is invalid that an A is just as much better than a B as a D is better than an F. The second significant point is that the symbols representing grades are ingrained in the educational culture in which the cultural role of the symbols is at least as important as their psychometric properties. The decision that a student shall be eligible to take further advanced courses in a department is as much a socioculture decision as it is psychometric.

In most schools, an equilibirum is reached between the grading symbol system and the social consequences of

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[6] Thorndike, R. L., Hagen, E., op. cit., p. 580.

particular grades. The percentage of academic failure remains fairly stable from year to year. Average grades within a department maintain themselves at a fairly stable level, though varying from department to department. New faculty members are informally initiated into the culture, and maintain its general character, though imposing their individuality upon it. In the past, this equilbirum has been intuitive and unexamined. It has been unresponsive to changing events such as a shift in the academic character of a student body. The cultural norms as to how grading symbols are used throughout a school are worthy of continual inspection to ensure that the categories are used in ways that serve the purposes of the school itself and the larger educational system of which it is a part.

Grades are assigned in reference to three concepts.[7] These are performance in relation to contemporaries, performance in relation to potential, and performance in relation to perfection. The first concept, in its simplest form, is one that does not go beyond the single instructor. Grades could then be assigned either in relation to a specific class or in relation to the more general personal standard held by the instructor. If the specific class is used to provide the reference concept, there is always the possibility that the students in one class may be in some

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[7] Thorndike, R. L., Hagen, E., op. cit., p. 586

way unrepresentative so that each student may receive an unjust penalty, or an unwarranted bonus because of the nature of that reference group. If the personal standard is used, the question is raised as to the subjectivity and its variability from instructor to instructor, and quite possibly, from time to time, for a given instructor. Too often the instructor's impressions of what is excellent or average or unsatisfactory is based on his memories of that total group to previous students. The more complex form of grading relative to contemporary reference is that used in standardized test norms where the peer group is some broad national sample.

The second concept is the use of grades to report performance in relation to some estimate of potential to perform. There are definite problems in determining this estimate of potential, but of more significance at the graduate level is the question of what information is to be represented by the grading symbol. It seems more appropriate to determine what the individual can do - not whether he is doing his best.

The third concept is performance in relation to perfection. Performance in relation to perfection implies a degree of complete mastery. To catalogue all that exists to be learned is difficult enough when the material is finite and definable. However, for any specific class it is possible to detail class learning objectives. Examinations and subsequent grades are related to the student meeting these objectives.

C. REDEFINED STATEMENT OF THE PROBLEM

1. Definition Of Key Terms

The definitions of the following three terms are taken from the Naval Postgraduate School Catalogue For 1972-74.

An operational grading system is currently being used and evaluated by the Department of Aeronautics. The grades are operational instead of numerical and represent the level of degree credit granted for each course. No quality point ratio is computed under this system. An I grade is incorporated to provide remedial study as appropriate for unsatisfactory or incomplete work. The grading system also provides that all students are provided detailed specifications of course objectives. The objectives indicate the performance levels corresponding to the various possible course grades. The grading symbols and meanings are:

Symbol	Meaning
H - Honors	Confers credit toward graduate degree with honors.
G - Graduate	Confers credit toward a graduate or baccalaureate degree.
S - Satisfactory	Confers credit toward a baccalaureate degree but not toward a graduate degree.
I - Incomplete	Indicates incomplete or deficient work. Student has one year to remedy deficiency or the grade of I is superseded by the original grade earned.

N - No Credit Confers no degree credit for the course.[8]

The ultimate use of the H grade is for the purpose of recognizing outstanding academic performance and granting a degree with honors. The present requirement for a degree with honors is the upper 10% of the graduates. The present policy of the operational grading system is to award H for 15% of all grades. a Department committee then selects the honor graduates based on grades and the quality of thesis.

A plus/minus grading system is in use by the remaining departments of the School. Presently, the student is given the benefit of the higher Quality Point Ratio for graduation purposes by computations with the plus/minus grades and with the plus/minus rounded off to the whole letter. Academic performance is evaluated on the basis of a quality point value assigned to the letter grade.

Performance	Grade	Point Value
Excellent	A	4.0
	A-	3.7
	B+	3.3
	B	3.0
	B-	2.7
	C+	2.3
	C	2.0
	C-	1.7
	D+	1.3
	D	1.0
Failing	X	0.0

The term Quality Point Ratio is equivalent to the more familiar Grade Point Average. It is computed by

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[8] Naval Postgraduate School, Catalogue for 1972-74, p.68

multiplying the quality point number of the letter grade by the quarter hours value of a course and then dividing the sum of the quality points for all courses by the sum of the quarter hour value of all courses.[9]

2. Significance

Unlike other known graduate schools, student admissions to the Naval Postgraduate School are not internally controlled. Selection boards at the Headquarters level of all the Armed Forces select students on several criteria including past academic performance, job performance within the service, and specific recommendations of superiors. To prevent the Naval Postgraduate School from becoming a service trade school, academic rigor and standards must be subject to continued inspection and review. The grading system is integral to the efficient control of the academic standards.

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[9] Naval Postgraduate School, Catalogue For 1972-74, p.17

II. PROCEDURES

A. FACULTY QUESTIONNAIRE

Two hundred and forty-eight faculty questionnaires were distributed to the various academic departments of the Naval Postgraduate School during March 1973. The author assisted in the preparation of this questionnaire; distribution was made under the title of the NPS Academic Council. One hundred and seventy-seven questionnaires were completed and returned in sufficient time to be included in the data analysis. An additional 22 questionnaires were completed but were returned subsequent to the data analysis. The total return rate was 80.5%.

The purpose of the faculty questionnaire was to determine the academic impact of the plus/minus grading system. The questionnaire included five questions and nine variables and was based on the factors influencing faculty preference between the plus/minus system and the prior ABCDX system, the reasons for the preference, and the extent of the use of the plus/minus system as dependent upon the general type of course.

This questionnaire was administered under the appointment of an Ad Hoc Committee of the NPS Academic Council. The Committee was charged with the specific objective of determining the impact of the plus/minus grading system, and, therefore, no questions were asked relating to other types of grading systems. Appendix A is a sample of the faculty questionnaire.

B. CURRICULAR OFFICER QUESTIONNAIRE

The academic programs and direct supporting functions of the Naval Postgraduate School are administered and operated through the Curricular Offices and Academic Departments. The Curricular Offices are staffed by naval officers and the Academic Departments by civilian faculty members. The primary functions are academic counseling, curriculum development, and liaison with curricular sponsor representatives. The author assisted in the design and administration of the Curricular Office questionnaire. The purpose of the questionnaire was to determine the suitability of the plus/minus grading system in meeting the functions of the Curricular Office.

Ten questionnaires were administered and all ten were completed and returned. Appendix B is a sample of the questionnaire.

C. STUDENT QUESTIONNAIRE

The student questionnaire was designed and distributed by the author. On March 1, 1973, 1,506 questionnaires were distributed through the Student Mail Center to the Naval Postgraduate School student body. Five hundred and eighty-three questionnaires were completed and returned in sufficient time to be included in the statistical analysis. An additional forty-one questionnaires were completed but were not included in the analysis because of the extreme delay in response. The total responses represented 41.4% of the student body, which initially appeared

to be a disappointing return. However, several student questionnaires for other research projects were administered during the same time period and the response rate for these questionnaires varied from ten to fifteen percent. The relatively high response rate is directly attributed to the interest in student evaluation at the Naval Postgraduate School.

The student questionnaire consisted of eleven questions including seventeen variables. The purposes of the questionnaire were to determine student opinion of the plus/minus grading system relative to the traditional ABCDX system, student preference as to a best grading system, student opinion as to factors influencing study effort, and student opinion on the effect of implementing a pass/fail grading system at the Naval Postgraduate School. Appendix C is a sample of the student questionnaire.

D. STATISTICAL ANALYSIS

The Statistical Package for the Social Sciences (SPSS) is an integrated system of computer programs for the analysis of social science data. The system has been designed to provide the social scientist with a unified and comprehensive package enabling him to perform many different types of data analysis.[10]

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[10] Bent, D. H., Hull, C. H., Nie, N. H., Statistical Package for the Social Sciences, p. 1, McGraw-Hill Book Company, 1970.

The subprogram CODEBOOK was used initially for the basic examination of the data obtained from the faculty and student questionnaires. Values obtained from this subprogram were the frequency with which each value occurred, the relative frequency, the mean, mode, minimum, maximum, standard deviation, and range. Once the subprogram CODEBOOK was run for each questionnaire on the IBM 360 computer, sets of relationships were investigated. The subprogram selected for this purpose was CROSSTABS. CROSSTABS permits the user to compile two-way to n-way crosstabulations of variables and to compute a variety of nonparametric statistics based on these tables. CROSSTABS produces a sequence of two-way tables showing along the vertical dimension the values of one variable and along the horizontal dimension the values of a second variable. In the body of the table occur the frequency counts of the number of occasions in which the two variables took each possible combination of values. These frequency counts are expressed as a percentage of the row total, column total, and the table total. The statistics used to measure the degree of association of the two variables, based on the distribution of frequency counts in the table, included chi-square, Cramers V, Kendall's tau B and C, the gamma statistic, and Somer's D.[11]

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[11] Bent, D. H., Hull, C. H., Nie, N. H., op. cit., p. 104

E. REGISTRAR DATA

The statistical information reflected in Tables X and XI was obtained from the Naval Postgraduate School Registrar's Office. These tables show the number of grades and average Quality Point Ratio (QPR) given by each department and by the entire School, according to the level of the courses offered. Table XII was manually computed from Table XI and indicates the percentile tabulation of the plus/minus grading system for Quarters III and IV of Academic Year 72. Table XIII was developed to indicate the summary of grades by department for all quarters of Academic Year 71, Quarters I and II, and Quarters III and IV of Academic Year 72. The data in Table XIV were obtained from the Registrar's Office, and indicate the trends in grade distributions for the five year period from 1967 through 1972.

III. FINDINGS

A. FACULTY QUESTIONNAIRE

Question 1 asked, "Did you prefer the plus/minus grading system, over the ABCDX system, prior to its implementation in January, 1972?"

Response	Absolute frequency	Relative frequency (percent)
Yes	111	62.7
No	52	29.4
Not applicable	14	7.9
	177	100.0

Question 2 asked, "Do you now prefer the plus/minus system over the ABCDX systems?"

Response	Absolute frequency	Relative frequency (percent)
Yes	145	81.9
No	32	18.1
	177	100.0

The above two questions and findings were run on the subprogram CODEBOOK. A change in faculty preference was noted in the responses to the two questions, so the subprogram CROSSTABS was run with the results tabulated in Table 1.

The upper number in each cell is the cell amount or absolute frequency; the lower number is the column percentage. With allowance made for rounding, the sum of each column's percentages should approximate 100 percent. The upper

numbers in the row totals and column totals are equal to the sum of the row cell frequencies for the respective rows and columns. The number below each row or column total is the percentage which that row or column is of all rows or columns. The total number of cases on which the table is based is given in the lower right corner of the table.

TABLE I

Preference '72 by Preference '73

Count / Row pct / Col pct / Tot pct	Yes	No	Row Total
Yes	111	0	111
	100.0	0.0	62.7
	76.6	0.0	
	62.7	0.0	
No	20	32	52
	38.5	61.5	29.4
	13.8	100.0	
	11.3	18.1	
NA	14	0	14
	100.0	0.0	7.9
	9.7	0.0	
	7.9	0.0	
	145	32	177
	81.9	18.1	100.0

Chi square - 93.89911 with 2 degrees of freedom
Cramer's V - 0.72836
Contingency coefficient - 0.58874
Kendall's Tau B = 0.50776
Kendall's Tau C = 0.39361
Gamma = 0.77600
Somer's D = 0.66897

The important elements in Table 1 are:

(1) 111 preferred the plus/minus system in 1972; of these 111, none changed their preference in 1973.

(2) 52 did not prefer the plus/minus system in 1972; of these 52, 20 changed their preference to the plus/minus grading system in 1973.

(3) 14 new instructors were not at the school in 1972; all 14 new instructors are in favor of the plus/minus grading system in 1973.

(4) The statistics indicate a significant preference for the plus/minus grading system.

Question 3 requested, "Indicate the reasons for your preference in question 2 by checking one or more of the following:

a. Fairness to the student.

b. Consistent with my ability to discriminate among levels of student performance.

c. Students prefer it.

d. Useful for making recommendations for advanced study.

e. Other (specify).

The instructors indicating fairness is indicated as follows:

Response	Absolute frequency	Relative frequency (percent)
Yes	122	68.9
No	55	31.1
	177	100.0

Of particular interest was the distinction between those instructors preferring the plus/minus system and indicating fairness to the student as a reason and those instructors in opposition to the system and indicating

fairness to the student as a reason. Table II illustrates this distinction.

TABLE II

Preference '73 by Fairness

		Fairness to Student		
	Count / Row pct / Col pct / Tot pct	Yes	No	Total
Preference of Plus/ Minus Grading System in '73	Yes	117 80.7 95.9 66.1	28 19.3 50.9 15.8	145 81.9
	No	5 15.6 4.1 2.8	27 84.4 29.1 15.3	32 18.1
	Column Total	122 68.9	55 31.1	177 100.0

Corrected Chi square = 48.82205 with 1 degree of freedom
Phi = 0.52520
Contingency coefficient = 0.46497
Kendall's Tau B = 0.54106
Kendall's Tau C = 0.38546
Gamma = 0.91513
Somer's D = 0.44993

The important elements from Table II are that:

(1) of 122 instructors that indicated fairness to the student as a preference reason, 117 preferred the plus/minus grading system.

(2) The statistical tools indicate a significant percentage of the instructors prefer the plus/minus grading system because of fairness to the student.

The responses of instructors, apropos whether or not they had the ability to discriminate among levels of student performance, is indicated as follows:

Response	Absolute frequency	Relative frequency (percent)
Yes	134	75.7
No	43	24.3
	177	100.0

Of particular interest was the distinction between those instructors preferring the plus/minus system in 1973 and indicating the ability to discriminate among student performances, and those instructors not in favor of the plus/minus grading system who also indicated the ability orlack of ability to discriminate among student performances. Table III illustrates this distinction.

TABLE III

Preference '73 by Discrimination Ability

Faculty Discrimination Ability

	Count / Row pct / Col pct / Tot pct	Yes	No	Total
Preference of Plus/Minus Grading System in '73	Yes	114	31	145
		78.6	21.4	81.9
		85.1	72.1	
		64.4	17.5	
	No	20	12	32
		62.5	37.5	18.1
		14.9	27.9	
		11.3	6.8	
	Column Total	134	43	177
		75.7	24.3	100.0

Corrected chi square = 2.87946 with 1 degree of freedom
Phi - 0.12755
Contingency coefficient = 0.12652
Kendall's Tau B = 0.14466
Kendall's Tau C = 0.09550
Gamma = 0.37626
Somer's D = 0.12982

The instructor's responses to the question concerning student preference as a reason for a plus/minus grading system were as follows:

Response	Absolute frequency	Relative frequency (percent)
Yes	22	12.4
No	155	87.6
	177	100.0

The instructor's responses to the question concerning advanced study as a reason for preferring the plus/minus grading system were as follows:

Response	Absolute frequency	Relative frequency (percent)
Yes	31	17.5
No	146	82.5
	177	100.0

The instructors' responses to the question concening othe reasons for preferring the plus/minus grading system were as follows:

Response	Absolute frequency	Relative frequency (percent)
Yes	22	12.4
No	155	87.6
	177	100.0

The 22 instructors specifying other reasons for preferring the plus/minus grading system indicated a variety of such reasons. No specific reason was representative of this small group.

Question 4 of the faculty questionnaire asked, "Do you tend to use plus/minus grades more with some types of courses than with others?" The responses were:

Response	Absolute frequency	Relative frequency (percent)
Yes	36	20.3
No	141	79.7
	177	100.0

79.7% of the faculty use plus/minus grades for all types of courses. Question 5 investigates the type of courses that the remaining 20.3% of the faculty regard as more suitable for plus/minus grades.

Response	Absolute frequency	Relative frequency (percent)
Lower level	4	2.3
Upper level	5	2.8
Graduate level	12	6.8
Laboratory	3	1.7
Objective	5	2.8
Other	7	4.0
None	141	79.7
	177	100.0

The relative frequency column indicates that there is no significant type of course which the faculty regard as more suitable for plus/minus grades than for ABCDX grades.

B. CURRICULAR OFFICER QUESTIONNAIRE

Because of the limited number of questions in this questionnaire, and the limited number of total responses, the findings are summarized in a subjective format.

Question 1 asked, "On the basis of your experience with the plus/minus grading system for the past year, have

you any judgment as to its suitability for your purposes as compared with the old ABCDX systems?"

Three curricular officers stated that the plus/minus system has marginal advantages. One said the minus grade is more useful in counseling because it is more specific. One said the plus/minus system gives more insight into the potential of a marginal student. Four believe the two systems are equally suitable. One of these commented that he did not think the plus/minus was worth the additional effort. One opposed the plus/minus system because it emphasizes grading; he favored the operational grading system.

Question 2 asked, "Is there any use made of student grades within the Navy, beyond this school, that is served more effectively by the new grading system?"

Nine said they knew of none. One said he believed the plus/minus system would be more helpful in reviewing transcripts for candidates for Ph. D. programs or special schools.

Question 3 asked, "Do you have any other comments on the new plus/minus system in comparison with the standard ABCDX system, from your point of view as a curricular officer?"

Three offered comments basically favorable to the plus/minus system. All three pointed out the greater detail or discrimination in grading. One observed that it permits a "mediocre" student, who cannot get As, to

show his strengths with plus grades. One felt it was more flexible and would actually prefer an even finer distinction based on 4.0 to 0.0. Three presented basically unfavorable comments. Two criticized the plus/minus system on the grounds that it puts undesirable emphasis on grades. One doubted the validity of the finer distinctions being made and also noted that no student is now likely to have the satisfaction of a 4.0 QPR (as he is almost certain to get at least one A-). One stated that he favored retaining the plus/minus system only if the dual computation of the QPR for marginal students is also retained. One suggested that the plus and minus grades be retained for the faculty but for transcript purposes, all As should be converted to 4.0, all Bs to 3.0, and so forth.

C. STUDENT QUESTIONNAIRE

Question 1 was designed to provide some identification of the respondent. These variables were curriculum, QPR, and the number of quarters in residence at the Naval Postgraduate School as a student. The findings of variable 1, question 1 are presented in Table IV.

TABLE IV

Curriculum	Absolute frequency	Relative frequency (percent)
Advanced science	10	1.7
Aeronautical engineering	22	3.8
B. S./ B. A.	108	18.5
Electronic & Comm. Eng.	65	11.1
Environmental sciences	38	6.5
Engineering science	43	7.4
Management & Comp science	156	26.8

Naval Engineering	15	2.6
Operations research	109	18.7
Ordnance engineering	17	2.9
	583	100.0

The response rate by curriculum is regarded as a satisfactory representation of the student body.

Variable 2 of question 1 requested the QPR of the student. Because of the extreme number of unique responses, a broad coding scheme was deemed essential. Significant QPR ranges were conceived as follows:

3.65-4.00 This is the range of QPR necessary for the Dean's List.

3.20-3.64 This is a comfortable QPR range falling short of the Dean's List yet sufficiently high enough above the 3.00 M. S. degree requirement to eliminate undue QPR consciousness.

2.80-3.19 This range includes a critical variance above and below the 3.0 degree requirement.

2.20-2.79 A student with a QPR in this range has little chance of obtaining a graduate degree, however his QPR is still satisfactory relative to the School's requirements.

1.80-2.19 2.00 is the minimum requirement for satisfactory academic performance.

Table V indicates the QPR range by frequency count.

TABLE V

QPR	Absolute frequency	Relative frequency (percent)
1.80-2.19	7	1.2
2.20-2.79	48	8.2
2.80-3.19	213	36.5
3.20-3.64	173	29.7
3.65-4.00	120	20.6
Not applicable	22	3.8
	583	100.0

The 22 students indicating that QPR is not applicable were all Aeronautical Engineering students who are graded under the operational grading system.

Variable 3 of question 1 asked for the student's quarter of residence at the Naval Postgraduate School. The responses were coded into three categories.

Quarters	Absolute frequency	Relative frequency (percent)
1-3	268	45.9
4-7	231	39.6
8 or more	84	14.5
	583	100.0

These results indicate a representative range of the student body. The responses to the questionnaire might have been considered prejudiced if an overwhelming percentage of students were relatively new to the Naval Postgraduate School environment.

Question 2 asked, "Were you in favor of the change from the former ABCDX system to the plus/minus system when it was introduced during Quarter III, AY-72?"

Response	Absolute frequency	Relative frequency (percent)
Yes	162	27.8
No	143	24.5
No opinion	77	13.2
Not applicable	201	34.5
	583	100.0

Question 3 asked, "Do you now prefer the present plus/minus system over the ABCDX system?"

Response	Absolute frequency	Relative frequency (percent)
Yes	286	49.0
No	178	30.5

No opinion	70	12.0
Not applicable	49	8.5
	583	100.0

Of particular interest was the relation between those students in favor of the change in 1972 and their preference in 1973. The subprogram CROSSTABS was used to produce Table VI.

TABLE VI

Favor of Change '72 by Preference '73

Prefer Plus/Minus System in '73

	Count / Row pct / Col pct / Tot pct	Yes	No	No opinion	NA	Total
Favor of Change from ABCDX to Plus/Minus in '72	Yes	149	8	2	3	162
		91.9	5.0	1.2	1.9	27.8
		52.1	4.5	2.9	6.1	
		25.4	1.4	0.3	0.5	
	No	17	118	8	8	143
		11.9	82.5	5.6	0.0	24.5
		6.0	66.3	11.4	0.0	
		2.9	20.2	1.4	0.0	
	No Opinion	31	15	30	1	77
		40.3	19.5	39.0	1.3	13.2
		10.9	8.4	42.9	2.0	
		5.3	2.6	5.1	.2	
	NA	88	37	30	45	201
		43.8	18.4	14.9	22.4	34.5
		31.0	20.8	42.9	91.8	
		15.1	6.3	5.1	7.7	
	Column Total	285	178	70	49	583
		49.0	30.5	12.0	8.4	100.0

Chi square = 709.44800 with 16 degrees of freedom
Cramer's V = 0.55156
Gamma = 0.46410

The significant elements of Table VI are that 5.0% changed their preference from "yes" in 1972 to "no"in 1973,

but 11.9% changed their preference from "no" in 1972 to "yes" in 1973.

Question 4 asked, "What effect do you believe the plus/minus system has had or will have on your QPR?"

Response	Absolute frequency	Relative frequency (percent)
Positive	193	33.1
Negative	158	27.1
No effect	189	32.4
Not applicable	43	7.4
	583	100.0

Question 5 asked, "Do you believe that instructors can reliably make the finer distinction involved in the plus/minus system?"

Response	Absolute frequency	Relative frequency (percent)
Yes	335	57.4
No	197	33.8
No opinion	35	6.0
NA	16	2.8
	583	100.0

The faculty questionnaire indicated that 75.7% of the faculty believed that they have the ability to make the finer distinction required with the plus/minus system but only 57.4% of the students have this opinion of instructor ability.

Question 6 was not a forced answer. It requested, "Of all the grading systems that you are familiar with, state the one system that you consider the best."

Grading system	Absolute frequency	Relative frequency (percent)
Pass/Fail	276	47.3
ABCDX	94	16.1

Plus/Minus	141	24.2
Other	25	4.3
No Opinion	47	8.1
	583	100.0

In the student opinion poll in 1970 on grading system, the pass/fail system received 56.3%, the ABCDX system 31.3%, and the plus/minus system 12.3% of the total response. Question 6 of the 1973 questionnaire was not a forced selection. With this factor in consideration, the 47.3% favoring pass/fail is comparable to the 56.3% of 1970. However there has been a dramatic shift in student preference relative to the ABCDX system and the plus/minus system. The percentile of the student body preferring the traditional ABCDX grading system has declined from 31.3% to 16.1%. The plus/minus advocates have increased from 12.3% to 24.2%.

An investigation, through the use of the subprogram CROSSTABS, was made into student curriculum and grading system preference. The resulting lengthy table is not published as all of the percentiles by curriculum approximate those of the entire school. There was one curriculum, however, which was a significant exception. Of the 22 Aeronautical Engineering students, 17 (77.8%) considered pass/fail as the best grading system. The next highest percentile favoring a pass/fail system was 47.7% of those students in the Advanced Science curriculum.

Question 7 requested, "Please rank, in order of their importance, the following factors which may have had an

influence on your study effort at the Naval Postgraduate School."

a. sincere interest in course subject matter
b. the 3.0 QPR requirement for degree completion
c. the enthusiasm generated by a specific instructor
d. comparative QPR ranking with contemporaries
e. the significance of QPR for future promotion

The ranking was accomplished on a descending order with 1 indicating the factor of greatest importance and 5 the factor of least importance. The following matrix presents the findings of question 7.

Order of Influence	Five influence factors as indicated above. a.	b.	c.	d.	e.	Totals
1	239	220	74	35	15	583
2	189	87	192	77	38	583
3	88	142	174	142	37	583
4	47	83	98	262	93	583
5	20	51	45	67	400	583
	583	583	583	583	583	

In general, the factors of greatest influence on student effort are interest in the subject matter, the QPR requirement, and the instructor's enthusiasm. Contemporary ranking and any QPR influence on future promotions are regarded as having little influence on student effort. Of particular interest was the relation between QPR and the most important influence factor relating to student study effort. In the following matrix, the totals by row are the QPR totals found in Table V. The column totals are the figures for the first rank as indicated in each column of the preceding matrix.

QPR	Five influence factors of question 7.					
	a.	b.	c.	d.	e.	Total
3.65-4.00	51	0	33	22	14	120
3.20-3.64	83	73	8	9	0	173
2.80-3.19	64	124	20	4	1	213
2.20-2.79	18	23	7	0	0	48
1.80-2.19	5	0	2	0	0	7
NA	17	0	5	0	0	22
Total	238	220	74	35	15	

Several observations from this matrix are considered significant. From the Dean's List QPR range of 3.65 to 4.00, no student ranked the 3.0 QPR requirement as the primary influence on student academic effort. The factors of contemporary ranking and QPR influence on future promotions received the highest rankings from those students with the highest QPR. As might be expected, those students that ranked the 3.0 QPR requirement as most significant had a QPR within a close variance of the requirement. The 22 Aeronautical Engineering students that have no QPR requirements all indicate course interest and instructor enthusiasm as the factors of greatest influence on their effort.

Table VII is a crosstabulation of the "best grading system" preference of question 6 compared to the QPR identification value from question 1.

TABLE VII

QPR by Best System

Count / Row pct / Col pct / Tot pct	Pass Fail	ABCDX	Plus Minus	Other	No Opinion	Total
1.80-	0	3	1	1	1	6
2.19	0.0	50.0	16.7	16.7	16.7	1.0
	0.0	3.2	0.7	4.0	2.1	
	0.0	0.5	0.2	0.2	0.2	
2.20-	29	4	12	0	3	48
2.79	60.4	8.3	25.0	0.0	6.3	8.2
	10.6	4.3	8.5	0.0	6.4	
	5.0	0.7	2.1	0.0	0.5	
2.80-	125	22	43	4	18	213
3.19	58.7	10.3	20.2	1.9	8.5	36.5
	45.8	23.4	30.5	16.0	38.3	
	21.4	3.8	7.4	0.7	3.1	
3.20-	57	30	58	12	16	173
3.64	32.9	17.3	33.5	6.9	9.2	29.7
	20.9	31.9	41.1	48.0	34.0	
	9.8	5.1	9.9	2.1	2.7	
3.65-	45	33	24	7	9	119
4.00	37.8	27.7	20.2	5.9	7.6	20.4
	16.5	35.1	17.0	28.0	19.1	
	7.7	5.7	4.1	1.2	1.5	
NA	17	2	2	1	0	22
	77.3	9.1	9.1	4.5	0.0	3.8
	6.2	2.1	2.1	4.0	0.0	
	2.9	0.3	0.3	0.2	0.0	
Column Total	273	94	141	25	47	583
	46.8	16.1	24.2	4.3	8.1	100.0

Chi square = 268.12134 with 35 degress of freedom
Cramer's V - 0.30328
Gamma = 0.11198

The significant elements of Table VII are:

(1) 60.4% of the students within the 2.20-2.79 QPR range favor a pass/fail system.

(2) 58.7% of the students within the 2.80-3.19 QPR range favor a pass/fail system.

(3) 32.9% of the students within the 3.20-3.64 QPR range favor a pass/fail system.

(4) 37.8% of the students within the 3.65-4.00 QPR range favor a pass/fail system.

Question 8 was not a forced answer. It requested, "What is your present average weekly study time?" Because of the extreme number of unique answers, the responses were coded into four broad ranges of hours.

Response (hours)	Absolute frequency	Relative frequency (percent)
0-15	105	18.0
16-30	297	50.9
31-45	126	21.6
45 & more	55	9.4
	583	100.0

The above question 8 was a lead-in question to question 9 which asked "If a pass/fail was adopted, what would be the effect on your applied study time?"

Response	Absolute frequency	Relative frequency (percent)
Increase	27	4.6
Decrease	128	22.0
No effect	419	71.9
NA	9	1.5
	583	100.0

Question 10 asked, "What do you believe would be the effect, on your overall learning experience, of a pass/fail grading system?"

Response	Absolute frequency	Relative frequency (percent)
Favorable	292	50.0
Unfavorable	102	17.5
No effect	178	30.5
NA	11	1.9
	583	100.0

A set of relationships that was investigated was QPR, study time, and the effect of a pass/fail system on learning experience. Through the use of the subprogram CROSSTABS, Table VIII was constructed. This table specifically illustrates the relationship of QPR and study time for those students indicating a favorable response to the effect of pass/fail on learning experience.

TABLE VIII

QPR by Study Time (Hours per Week)

Controlling for Effect Pass/Fail on Learning Experience

Favorable

Count Row pct Col pct Tot pct	0-15	16-30	31-45	46 & More	Total
1.80- 2.19	0 0.0 0.0 0.0	3 75.0 2.0 1.0	1 25.0 1.5 0.3	0 0.0 0.0 0.0	4 1.4
2.20- 2.79	2 6.1 5.0 0.7	19 57.6 12.9 6.6	9 27.3 13.4 3.1	3 9.1 8.3 1.0	33 11.4
2.80- 3.19	17 13.4 42.5 5.9	63 49.6 42.9 21.7	29 22.8 43.3 10.0	18 14.2 50.0 6.2	127 43.8
3.20- 3.19	9 13.0 22.5 3.1	38 55.1 25.9 13.1	16 23.2 23.9 5.5	6 8.7 16.7 2.0	69 23.8
3.65- 4.00	10 21.7 25.0 3.4	18 39.1 12.2 6.2	11 23.9 16.4 3.8	7 15.2 19.4 2.4	46 15.9

TABLE VIII (continued)

	0-15	16-30	31-45	46 & More	Total
NA	2	6	1	2	11
	18.2	54.5	9.1	18.2	3.8
	5.0	4.1	1.5	5.6	
	0.7	2.1	0.3	0.7	
Column	40	147	67	36	290
Total	13.8	50.7	23.1	12.4	100.0

Chi square = 10.26354 with 15 degress of freedom
Cramer's V = 0.10861
Gamma = 0.05951

Table IX is similar to Table VIII except the controlling factor of the effect of a pass/fail system is unfavorable. No responses were in the 1.80-2.19 and not applicable QPR ranges therefore they were deleted from the table.

TABLE IX

QPR by Study Time (Hours per week)

Controlling for Effect Pass/Fail on Learning Experience

Unfavorable

Count Row pct Col pct Tot pct	0-15	16-30	31-45	46 & More	Total
2.20-	0	0	2	0	2
2.79	0.0	0.0	100.0	0.0	2.0
	0.0	0.0	10.0	0.0	
	0.0	0.0	2.0	0.0	
2.80-	7	13	5	1	26
3.19	26.9	50.0	19.2	3.8	25.5
	33.3	23.2	25.0	20.0	
	6.9	12.7	4.9	1.0	
3.20-	10	24	9	2	45
3.64	22.2	53.3	20.0	4.4	44.1
	47.6	42.9	45.0	40.0	
	9.8	23.5	8.8	2.0	

TABLE IX (continued)

	0-15	16-30	31-45	46 & More	Total
3.65-	4	19	4	2	29
4.00	13.8	65.5	13.8	6.9	28.4
	19.0	33.9	20.0	40.0	
	3.9	18.6	3.9	2.0	
Column	21	56	20	5	102
	20.6	54.9	19.6	4.9	100.0

Chi square - 10.96388 with 9 degrees of freedom
Cramer's V - 0.18929
Gamma = 0.01642

Tables are not included for the controlling responses of no effect and not applicable. The results of these relationships compared generally with those of Tables VIII and IX. The important elements from Tables VIII and IX are:

(1) There is no significant relationship between QPR and the quantity of study time.

(2) There is a relatively strong relationship between QPR and the opinion of the effect of a pass/fail system on learning experience. In general, the lower the QPR the greater the opinion that a pass/fail grading system would have a favorable influence on the learning experience.

Question 11 asked, "In your opinion, how appropriate is the emphasis placed on grades at the Naval Postgraduate School?"

Response	Absolute frequency	Relative frequency (percent)
Too much	400	68.6
Not enough	7	1.2
Just right	110	18.9
No opinion	66	11.3
	583	100.0

D. ANALYSIS OF GRADE DISTRIBUTIONS

All of the letter grades in Tables X through XIV were taken from the original grade sheet submissions and do not

reflect later corrections including the removal of incomplete grades. The average Quality Point Ratio (QPR) is not weighted according to course credit. For example, grades from a two quarter hour course are weighted equally with grades from a four quarter hour course.

Table X is the grade distribution by academic department for quarters 1 and 2 of academic year '72. This was the last two quarters that the ABCDX grading system was used. The table was obtained from the Naval Postgraduate School Registrar.

Table XI is the grade distribution by academic department for quarters 3 and 4 of academic year '72. This was the initial two quarters of the plus/minus grading system. This table was obtained from the Naval Postgraduate School Registrar.

Table XII is a conversion of Table XI into a percentile distribution. The most noteworthy observation concerning Table XII is the higher proportion of plus grades than of minus grades.

Table XIII represents a conversion of the preceding three tables. The totals in percentages for the entire school reflect a shift upward in the percentages of As and Bs given and a downward shift in percentages of C grades given.

Table XIV is the grade distributions for the past five years. All QPRs have been converted to the 4.0 scale. The upward shifts of the grade distributions noted in Table XIII

are not reflected in the average QPRs by department in quarters 3 and 4 of academic year '72 relative to quarters 1 and 2 of academic year '72. The change in average QPR for the entire school is from 3.21 to 3.22. The changes in prior years have been greater which were periods when the grading system of ABCDX was in total use. A change in QPR as a result of the change to the plus/minus system has not occurred, because the proportion of A and A- grades under the plus/minus system is equal to the proportion of As under the ABCDX system. This would lower the average QPR. However, the proportion of C+ grades is higher than the C- grades and the proportion of B+ grades is higher than the B- grades. These shifts in grade distributions tend to balance so the net effect is to produce no significant change in average QPR for the school.

TABLE X

1971-72 Quarters 1 & 2

GRADE DISTRIBUTION BY DEPARTMENTS

DEPARTMENT	A	B	C	D	X
Aeronautical Engineering					
2000 level	30	38	5	2	0
3000 level	17	24	0	0	0
4000 level	44	74	6	0	0
Total	91	136	11	2	0
Aviation Safety					
2000 level	52	56	21	0	0
Computer Science					
2000 level	63	108	51	1	1
3000 level	172	127	22	2	1
4000 level	92	35	0	0	0
Total	327	270	73	3	2
Electrical Engineering					
2000 level	326	407	155	18	4
3000 level	102	88	20	3	2
4000 level	158	110	25	0	1
Total	586	605	200	21	7
Government & Humanities					
1000 level	31	97	28	0	0
2000 level	230	489	139	5	0
3000 level	66	46	24	1	0
Total	327	632	191	6	0
Material Science & Chemistry					
1000 level	15	43	8	0	0
2000 level	24	53	20	1	0
3000 level	48	38	7	2	0

Table X (Continued)

4000 level	2	7	4	0	0
Total	89	141	39	3	0
Mathematics					
1000 level	137	214	119	29	6
2000 level	328	430	201	17	4
3000 level	154	253	73	5	0
4000 level	57	37	0	0	0
Total	676	934	393	51	10
Mechanical Engineering					
2000 level	64	75	51	7	0
3000 level	70	96	25	4	0
4000 level	45	39	11	1	0
Total	179	210	87	12	0
Meteorology					
2000 level	31	70	8	0	0
3000 level	70	66	17	1	0
4000 level	48	61	7	1	0
Total	159	184	49	2	0
Oceanography					
2000 level	31	70	8	1	0
3000 level	151	171	42	0	0
4000 level	65	111	7	0	0
Total	247	352	57	1	0
Operations Research and Administrative Sciences					
1000 level	30	15	0	0	0
2000 level	93	159	96	11	0
3000 level	936	1257	212	12	0
4000 level	648	711	40	3	0
Total	1707	2142	348	26	0

Table X (Continued)

Physics					
1000 level	92	160	67	3	1
2000 level	81	133	84	12	1
3000 level	51	116	18	0	0
4000 level	22	37	8	0	0
Total	246	446	177	15	2
Entire School					
1000 level	305	529	222	32	7
2000 level	1363	2075	856	75	10
3000 level	1837	2282	460	30	3
4000 level	1181	1222	108	5	1
Total	4686	6108	1646	142	21

The average QPR for the entire school for all levels of courses was 3.21.

TABLE XI

1971-72 Quarters 3 & 4

GRADE DISTRIBUTION BY DEPARTMENT

DEPARTMENT	A	A-	B+	B	B-	C+	C	C-	D+	D	X
Aeronautics											
2000 level	2	0	3	0	3	0	4	0	0	0	0
3000 level	2	0	0	8	1	0	1	0	0	0	0
4000 level	9	1	3	24	3	0	0	0	0	0	0
Total	13	1	6	41	7	0	5	0	0	0	0
Aviation Safety											
2000 level	69	4	25	67	4	2	22	0	0	2	0
Computer Science											
2000 level	45	24	17	62	17	13	25	6	0	2	0
3000 level	88	58	37	71	18	5	6	1	0	0	0
4000 level	52	13	4	11	1	0	1	0	0	0	0
Total	185	95	58	144	36	18	32	7	0	2	0
Electrical Engineering											
2000 level	206	83	57	197	63	29	71	5	1	5	2
3000 level	95	44	30	85	24	6	18	2	0	0	0
4000 level	167	44	41	110	23	9	19	2	0	3	0
Total	468	171	128	392	110	44	108	9	1	8	2

TABLE XI (Continued)

DEPARTMENT	A	A-	B+	B	B-	C+	C	C-	D+	D	X
Government & Humanities											
1000 level	7	18	24	47	33	25	17	0	0	0	0
2000 level	57	176	143	192	144	83	56	12	0	3	0
3000 level	49	22	6	6	10	11	3	1	1	0	0
Total	113	216	173	245	187	119	76	13	1	3	0
Mathematics											
1000 level	79	37	30	82	35	27	42	13	0	8	5
2000 level	146	69	74	164	71	43	95	17	1	22	8
3000 level	110	32	41	137	33	15	23	10	0	6	0
4000 level	27	16	11	6	2	0	0	0	0	0	0
Total	362	154	156	389	141	85	160	40	1	36	13
Mechanical Engineering											
1000 level	9	0	2	15	6	0	2	0	0	0	1
2000 level	28	8	11	37	11	11	24	11	4	11	1
3000 level	33	28	25	58	20	2	14	2	0	0	0
4000 level	27	11	20	29	9	2	3	1	0	0	0
Total	97	47	58	139	46	15	43	14	4	11	2
Meteorology											
2000 level	32	22	25	35	15	6	9	1	0	2	0
3000 level	31	38	29	26	17	13	2	3	0	0	0
4000 level	31	20	20	28	14	1	8	3	0	1	0

TABLE XI (Continued)

DEPARTMENT	A	A-	B+	B	B-	C+	C	C-	D+	D	X
Total	94	80	74	89	46	20	19	7	0	3	0
Oceanography											
2000 level	22	23	18	27	11	1	3	0	0	0	0
3000 level	97	33	60	90	31	10	14	2	0	0	0
4000 level	51	18	14	66	8	2	3	0	0	0	0
Total	170	74	92	183	50	13	20	2	0	0	0
Ops Res & Adm Science											
1000 level	36	0	0	17	0	0	0	0	0	0	0
2000 level	24	15	12	67	14	1	35	8	2	3	0
3000 level	626	212	265	917	106	34	120	14	0	9	0
4000 level	433	232	195	424	82	15	41	3	0	2	0
Total	1119	459	472	1425	202	50	196	25	2	14	0
Physics & Chemistry											
1000 level	50	33	34	79	28	32	44	21	1	3	0
2000 level	44	29	37	94	23	10	31	9	1	5	0
3000 level	29	12	5	34	9	2	1	0	0	0	1
4000 level	44	40	14	24	7	1	1	0	0	0	1
Total	167	114	90	231	67	45	67	30	2	8	2
Entire School											

TABLE XI (Continued)

DEPARTMENT	A	A-	B+	B	B-	C+	C	C-	D+	D	X
Entire School											
1000 level	181	88	90	240	102	84	105	34	1	11	6
2000 level	675	453	422	951	376	199	365	69	9	55	11
3000 level	1160	479	498	1432	269	98	202	35	1	15	1
4000 level	841	395	322	722	149	30	76	9	0	6	1
Total	2857	1415	1332	3345	896	411	748	147	11	87	19

TABLE XII

PERCENTILE GRADE DISTRIBUTION

Quarters III & IV 1971-72

DEPT	A	A-	B+	B	B-	C+	C	C-	D+	D	X
AERO	18	01	08	56	10	0	07	0	0	0	0
AV SAFETY	35	02	13	34	02	01	11	0	0	01	0
COMP SCI	32	17	10	25	06	03	06	01	0	0	0
ELEC ENG	33	12	09	27	08	03	08	01	0	01	0
GOV & HUM	10	19	15	21	16	10	07	01	0	0	0
MATH	24	10	10	25	09	06	10	03	0	02	01
MECH ENG	20	10	12	29	10	03	09	03	01	02	01
METRO	22	19	17	21	11	04	04	02	0	01	0
OCEANO-GRAPHY	28	12	15	30	08	02	03	01	0	0	0
ORAS	28	12	12	36	05	01	05	01	0	0	0
PHYSICS & CHEM	20	14	11	28	08	06	08	94	0	01	0
SCHOOL	25	13	12	30	08	04	07	01	0	01	0

The following example illustrates the procedures used in the formulation of the above Table XII. From Table XI, it is noted that a total of 13 A grades were given in the Aeronautics Department. The total number of grades for this Department was 73. Therefore the percentile representation is 13/73 or 17.8%. All values have been rounded to two figures in the above table.

TABLE XIII

SUMMARY OF GRADES BY DEPARTMENT[12]

DEPT	A-Grades			B-Grades			C-Grades		
	70-71	71-72	71-72	70-71	71-72	71-72	70-71	71-72	71-72
		I & II	III & IV		I & II	III & IV		I & II	III & IV
AERO	.371	.379	.192	.555	.561	.740	.074	.046	.068
AV SAFETY	.370	.403	.375	.426	.434	.493	.188	.163	.123
COMP SCI	-	.484	.486	-	.400	.413	-	.108	.098
ELEC ENG	.398	.413	.444	.407	.426	.447	.168	.141	.112
GOV & HUM	.212	.283	.287	.532	.547	.528	.247	.165	.181
MATH	.365	.327	.336	.458	.452	.446	.169	.190	.185
MECH ENG	.382	.367	.303	.440	.430	.511	.152	.178	.151
METEOROLOGY	.365	.404	.403	.468	.467	.483	.159	.124	.106
OCEANOGRAPHY	.386	.376	.404	.492	.537	.538	.119	.087	.058
ORAS	.393	.404	.398	.508	.507	.529	.091	.082	.068
PHYSICS & CHEM	.299	.327		.440	.518		.234	.143	
	.307	.278	.342	.486	.503	.471	.185	.200	.172
SCHOOL	.363	.372	.380	.477	.485	.495	.144	.131	.115

TABLE XIII (Continued)

SUMMARY OF GRADES BY DEPARTMENT[12]

DEPT	D-Grades			X-Grades		
	70-71	71-72 I & II	71-72 III & IV	70-71	71-72 I & II	71-72 III & IV
AERO	0	.008	0	0	0	0
AV SAFETY	.016	0	.010	0	0	0
COMP SCI	-	.004	.003	-	.003	0
ELEC ENG	.024	.014	.007	.003	.005	.001
GOV & HUM	.008	.005	.004	.001	0	0
MATH	.024	.025	.024	.004	.005	.008
MECH ENG	.025	.025	.031	.001	0	.004
METEOROLOGY	.008	.005	.007	0	0	0
OCEANOGRAPHY	.002	.002	0	.001	0	0
ORAS	.007	.006	.005	.001	0	0
PHSICS & CHEM	.024 .020	.011 .017	.012	.004 .002	0 .002	.002
SCHOOL	.014	.011	.009	.002	.002	.001

[12] This Table was formulated in the same manner as Table XII. For example, the percentage of A grades in the Aeronautics Department in academic quarters III & IV of 1971-72 was 19.2%. Table XI indicates that 18% of the grades were actually As and 1% A-x.

TABLE XIV

GRADE DISTRIBUTION STUDY
(Average QPRs by Department)

Department	67-68	68-69	69-70	70-71	1 & 2 71-72	3 & 4* 71-72
Aeronautics	3.22	3.36	3.20	3.30	3.32	3.12
Aviation Safety	-	3.31	3.35	3.15	3.24	3.26
Bus Ad & Econ	3.35	3.40	3.25	-	-	-
Electrical Eng	3.15	3.25	3.19	3.17	3.23	3.29
Govt & Human	2.74	2.75	2.83	2.95	3.11	3.06
MatSci& Chem	3.07	3.10	3.11	3.01	3.16	-
Math	2.97	3.10	3.11	3.14	3.07	3.06
Mech Eng	3.18	3.19	3.11	3.18	3.14	3.06
Meteorology	3.10	3.15	3.15	3.19	3.27	3.26
Oceanography	-	3.25	3.16	3.26	3.29	3.34
Ops Analysis	3.16	3.22	3.23	-	-	-
Physics	2.92	3.07	3.08	3.08	3.04	3.11
ORAS	-	-	-	3.29	3.31	3.30
Computer Science	-	-	-	-	3.36	3.34
Total	3.08	3.17	3.14	3.19	3.21	3.22

* Academic Quarters

IV. INTERPRETATION OF THE FINDINGS

A. REVIEW OF LEARNING AND MOTIVATION THEORY

In most discussions of motivation theory, the basic premise from which to begin is that human behavior revolves around the effort to satisfy needs and aspirations.[13] Basic is the need for physiological requirements. Examples of these fundamental needs are food, water, oxygen, rest, exercise, and shelter. Human needs are organized in a series of levels - a hierarchy of importance. The next higher level of needs are the safety needs. When man feels threatened or dependent, his greatest need is for protection and security. When man's physiological needs are satisfied and he is no longer fearful about his physical welfare, his social needs become important motivators of his behavior. Examples of the social needs are those for belonging, for acceptance by one's contemporaries, and for giving and receiving friendship. Above the social needs are the needs of greatest significance. They are the egoistic needs which are twofold. First are those that relate to an individual's self-esteem. Included are the needs for self-respect and self-confidence, for achievement, for competence, and for knowledge. Second are the needs that

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[13] H. J. Klausmeier, Learning and Human Abilities: Educational Psychology, p. 323, Harper & Row, 1961

relate to an individual's reputation. Included are the needs for status, for recognition, for appreciation, and for the deserved respect of one's contemporaries. Unlike the lower needs, these are rarely satisfied; man seeks indefinitely for more satisfaction of these needs once they have become important to him. Psychologists of reputation that subscribe in general to these simplified ideas of motivation are Maslow, McGregor, and Murray. Each has defined details within their particular theories but they have been influenced by the views of Freud, Jung, Adler, McDougall, Goldstein, Lewin, and Rogers among others.[14]

The mission of the Naval Postgraduate School as defined by the Secretary of the Navy is:

"To conduct and direct the Advance Education of commissioned officers, and to provide such other technical and professional instruction as may be prescribed to meet the needs of the Naval Service; and in support of the foregoing, to foster and encourage a program of research in order to sustain academic excellence."[15]

In fulfilling the mission of advanced education and sustaining academic excellence, the fundamental concept

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[14] Young, P. T., Motivation and Emotion, John Wiley & Sons, 1961, p. 589.

[15] Naval Postgraduate School, Catalogue for 1972-74, p. 3.

is that education is a process for changing the behavior patterns of individuals. These changes include the acquiring of new ideas, the improvement of ways of thinking, the modification of attitudes, and the development of tastes and sensitivities. The procedures of evaluation provide evidence on the effectiveness of the learning experiences and ultimately on the attainment of the objectives.[16]

There are a number of theories of learning. Three names appear in all extensive bibliographies. These are Thorndike, Hull, and Skinner. One impact of Thorndike's reward psychology on education was to make learning a function of pleasant student-teacher relationships and to introduce a full variety of rewards, gold stars, and honors. Hull restated Thorndike's Law of Effect, "Whenever a response is closely followed by a diminution of a drive or a drive stimulus, there will be an increment in the strength of the bond between the response and the stimulus present at the time the response is initiated."[17] Three assumptions are essential to understanding practical applications of Hull's postulates. According to Hull's views, there will be no learning unless a need is reduced and for a need to be reduced, a need must be present. Therefore motivation

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[16] Furst, E. J., Constructing Evaluation Instruments, Long-Mans, Green, and Co. 1958, p.3.

[17] Bugelski, B. R., The Psychology of Learning Applied to Teaching, Bobbs-Merrill Company, 1964, p. 68.

is fundamental to learning and must be established first. In addition, the rewards for learning are not essentially large and learning always proceeds in increments. Thorndike, Hull, and Skinner all based their entire systematic thinking on the proposition that without performance there is no learning. The emphasis on action is the result of their emphasis on rewards.

B. OTHER GRADING SYSTEMS AND THEIR SIGNIFICANCE

1. Graduate Level

A poll on the use of grading systems in 1969 by the Council of Graduate Schools indicated that approximately 46% of the graduate schools were actively using a pass/fail grading system. The majority of these schools have used a pass/fail system for less than five years. Evaluations of these systems have not been published because of the insufficient time to assess the advantages and disadvantages.[18]

2. Elementary and Secondary Level

The Monterey Peninsula Unified School District conducted a comprehensive grading system study prior to implementing an integrated written description and teacher-parent conference evaluation system in January 1973. The trend among elementary and secondary schools across the nation has been a wide-spread departure from the traditional

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[18] Benson, W. W., "Graduate Grading Systems," Proceedings of Ninth Annual Meeting; Council of Graduate Schools in the United States, December 4-6, 1969, p. 107.

ABCDX grading system. Pass/fail, conferences, and written evaluations are the significant trend. In New York City a child can fail only once in the primary grades and once in the junior high level. This virtually guarantees graduating from the eighth grade by age sixteen.

The long term implication of a student moving from a virtual all pass school into a grade competitive environment is not that predictable. Surely there will be a transition period requiring flexibility and understanding.

C. IMPLICATIONS OF FINDINGS OF THIS STUDY

From the behavioral objectives approach to education, there can be only one standard for passing. The product is either good enough or not good enough. Skinner has stated that under proper educational operations, all students will earn As.[19]

The Naval Postgraduate School student body is, collectively, well-paid, in excellent physical health, industrious, and mature. The physiological, safety, and social needs are relatively fulfilled. The results of question 7 of the student questionnaire indicated that 68.6% of the student body consider grades as over-emphasized. Grades, sincere curriculum interest, and instructor emthusiasm are perceived by the NPS students as being the primary

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[19] Bugelski, B. R., op. cit., p. 31.

motivational agents. Though a class may be essential to the core of a curriculum it is not necessarily interesting. Because of academic freedom, instructor tenure, and the rigidity of veterans' rights, not all instructors are enthusiastic and challenging. For grades under the pass/fail system to be a motivating influence, the fail mark must be used with full objectivity. One of the evils of the plus/minus system may be the grade averaging dilemma where a substantial Quality Point Ratio may be regarded as assets in the computer bank. A "fail" mark under the plus/minus system at the graduate level is a B- or lower. A fail mark under a pass/fail is several times more severe. If only a limited number of fails occur under a pass/fail system the real world problems of permanent change of station constraints and the time constraints of student residence will be encountered. Table XV is based on historical Quality Point Ratio data for the academic year 1970-71. It illustrates the extreme extent to which meaningful evaluation is sometimes not evident under the traditional grading system. This token grading of all pass would in all probability increase under a pass/fail system because of the implications of the fail grade.

TABLE XV

Token Grading

(Courses of High QPR : 1970-71)

Course	A	B	C	D	X
MA 3185	5	0	0	0	0
MA 3565	11	0	0	0	0
MA 3566	10	0	0	0	0
MA 4636	6	0	0	0	0
ME 4902	8	0	0	0	0
MN 4445	6	0	0	0	0
MN 4645	17	0	0	0	0
MN 4931	7	0	0	0	0
MR 3900	5	0	0	0	0
OA 3659	4	0	0	0	0
OA 4614	8	0	0	0	0
OA 4615	4	0	0	0	0
OA 4622	5	0	0	0	0
OA 4642	25	0	0	0	0
OA 4652	49	2	0	0	0
OA 4654	12	0	0	0	0
OA 4912	26	0	0	0	0
OA 4913	22	3	0	0	0
OA 4930	17	1	0	0	0
OC 4803	7	0	0	0	0
OC 4901	8	0	0	0	0
PH 3421	7	0	0	0	0
PH 4972	4	0	0	0	0
PH 4998	13	1	0	0	0
PS 4001	6	0	0	0	0
PS 4002	6	0	0	0	0
PS 4322	12	0	0	0	0
PS 4510	4	0	0	0	0
AE 4831	17	0	0	0	0
AE 4832	13	0	0	0	0
AE 4900	6	0	0	0	0
BI 3801	6	0	0	0	0
CH 3718	4	0	0	0	0
EE 3413	21	0	0	0	0
EE 3471	9	0	0	0	0
EE 3731	15	1	0	0	0
EE 4421	6	0	0	0	0
EE 4451	12	0	0	0	0
EE 4900	29	0	0	0	0

V. CONCLUSIONS AND RECOMMENDATIONS

For any policy to be successful, it must have the support of all elements of the organization. The plus/minus grading system relative to the ABCDX system has the significant support of the Naval Postgraduate School faculty and student body. The average Quality Point Ratio has not significantly changed within any academic department, nor for the School in its entirety, as a result of the change to the plus/minus grading system. Hypothesis I stated that the plus/minus grading system currently in practice at the Naval Postgraduate School is superior to the former ABCDX system. Hypothesis I has been tested and found acceptable. It is recommended that the plus/minus grading system be incorporated at the Naval Postgraduate School on a permanent basis.

Hypothesis II stated that a change from the present plus/minus grading system to a pass/fail system would be a lowering of the School's academic standards in that student study motivation is dependent to a significant degree upon a competitive grading system. From the findings of the student questionnaire, there was found to be no significant relationship between individual Quality Point Ratio and individual study effort. There was a high correlation between the preference for a pass/fail system and students with a low Quality Point Ratio.

However, the correlation between the preference for a pass/fail system and a high Quality Point Ratio was also significant. Those students that are graded under the operational grading system have a high degree of preference for their basically pass/fail system. However, the faculty was not queried on a pass/fail system and meaningful information on the results of the operational grading system was not available from the Registrar. From all of these conclusions, Hypothesis II is rejected.

It is recommended that a thorough study of the operational grading system of the Aeronautical Engineering Department be made by an independent source.

The subjective and intangible aspects of judgment which are criteria used in assigning an abstract symbol to represent student evaluation have troubled concerned educators since the adoption of grading systems.

Several of the bibliographical sources indicate that grading practices have been examined extensively in the last five years. That this is so is an indication of educational growth. Tolstoy said that the search for the answers bespeaks quality of soul and that the constant attempt to find answers to complex problems may ultimately be more beneficial and truly important than the answers themselves.[20]

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[20] The Oxford Dictionary of Quotations, p. 586, Oxford University Press, 1955.

APPENDIX A

FACULTY QUESTIONNAIRE

1. Did you prefer the plus/minus grading system, over the ABCDX system, prior to its implementation in January, 1972?

Yes_____ No_____

2. Do you now prefer the plus/minus system over the ABCDX system?

Yes_____ No_____

3. Indicate the reasons for your preference in question 2 above by checking one or more of the following:

a. Fairness to the student _____

b. Consistent with my ability to discriminate among levels of student performance _____

c. Students prefer it _____

d. Useful for making recommendations for advanced study _____

e. Other (specify) _____

4. Do you tend to use plus/minus grades more with some types of courses than with others?

_____

5. If the answer to question 4 is Yes indicate which types of courses would be more suitable for plus/minus grading. (Example: graduate level courses, reading courses, laboratory courses, etc.)

_____

APPENDIX B

CURRICULAR OFFICER QUESTIONNAIRE

1. On the basis of your experience with the plus/minus grading system for the past year, have you any judgment as to its suitability for your purposes as compared with the old ABCDX system?

2. Is there any use made of student grades within the Navy, beyond this school, that is served more effectively by the new grading system?

3. Do you have any other comments on the new plus/minus system in comparison with the standard ABCDX from your point of view as a curricular officer?

APPENDIX C

STUDENT QUESTIONNAIRE

The Academic Council is conducting a study on the academic impact of the present plus/minus grading system. Your response to the following questions will be appreciated.

1. Your curriculum._____ QPR._____ Number of quarters at NPS as a student._____.

2. Were you in favor of the change from the former A,B,C,D,X system to the plus/minus system when it was introduced during Quarter III, AY-72?

   Yes. No. No opinion. Not applicable.

3. Do you now prefer the present plus/minus system over the A,B,C,D,X system?

   Yes. No. No opinion. Not applicable

4. What effect do you believe the plus/minus system has had or will have on your QPR?

   Positive. Negative. No effect. Not applicable.

5. Do you believe that instructors can reliably make the finer distinction involved in the plus/minus system?

   Yes. No. No opinion. Not applicable.

6. Of all the grading systems that you are familiar with, state the one system that you consider the best.

   _____

Responses to the additional questions will provide partial data for an individual student research effort.

7. Please rank, in order of their importance, the following factors which may have had an influence on your study effort at NPS (use 1 through 5 in a descending order of ranking, i.e., 1 indicates the factor of greatest importance and 5 the factor of least importance).

   _____a. sincere interest in course subject matter
   _____b. the 3.0 QPR requirement for degree completion
   _____c. the enthusiasm generated by a specific instructor

_____d. comparative QPR ranking with contemporaries
_____e. the significance of QPR for future promotion

8. What is your present average weekly study time? _____

9. If a pass/fail was adopted, what would be the effect on your applied study time?

   Increase. Decrease. No effect. Not applicable.

10. What do you believe would be the effect, on your overall learning experience, of a pass/fail grading system?

    Favorable. Unfavorable. No effect. Not applicable.

11. In your opinion, how appropriate is the emphasis placed on grades at NPS?

    Too much emphasis. Not enough emphasis. Just right. No opinion.

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UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
Naval Postgraduate School Monterey, California 93940	Unclassified
	2b. GROUP

REPORT TITLE

AN ANALYSIS OF STUDENT GRADING AT THE NAVAL POSTGRADUATE SCHOOL

DESCRIPTIVE NOTES (Type of report and inclusive dates)

Master's Thesis; June 1973

AUTHOR(S) (First name, middle initial, last name)

William Gene Swarens

REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
June 1973	77	39

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO.	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d.	

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Naval Postgraduate School Monterey, California 93940

13. ABSTRACT

Among the significant controls influencing the academic excellence of a university are the mechanics and philosophy of the student grading system. The Naval Postgraduate School (NPS) has used three grading systems within a recent time period. The findings of faculty and student questionnaires indicate strong support for the plus/minus grading system over the more traditional ABCDX system. The Quality Point Ratio data for the initial two quarters of implementation of the plus/minus system reflect no significant trend which can be attributed to the change in grading systems. There is strong student opinion in favor of a further change to a pass/fail grading system. Recommended is an extensive study of the operational grading system in use by the Aeronautics Department at NPS.

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Grades						
Students						
Evaluation						
Motivation						

Thesis
S926
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Swarens
An analysis of student grading at the Naval Postgraduate School.